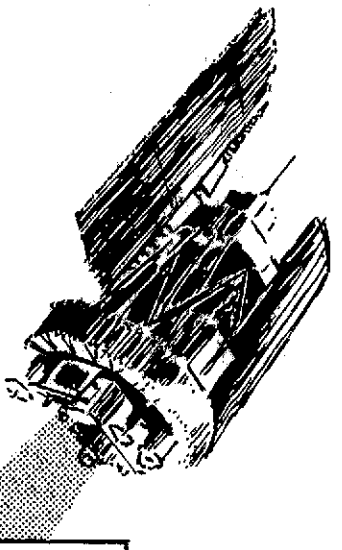
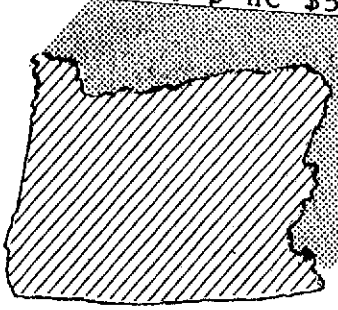
Remote Sensing Research and Applications in Oregon



SECOND-YEAR PROJECTS AND ACTIVITIES
OF THE
ENVIRONMENTAL REMOTE SENSING APPLICATIONS LABORATORY
(ERSAL)

BY

DAVID A. MOUAT AND BARRY J. SCHRUMPF



COORDINATED BY THE
ENVIRONMENTAL REMOTE
SENSING APPLICATIONS
LABORATORY.

OREGON
STATE
UNIVERSITY

Environmental Remote Sensing Applications Laboratory
Oregon State University
Corvallis, Oregon
97331

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ANNUAL PROGRESS REPORT TO:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OFFICE OF UNIVERSITY AFFAIRS
WASHINGTON, D.C. 20546

For the Period

1 April 1973 through 31 March 1974
Under NASA Contract No. 38-002-053

In Cooperation with State, County, and Municipal Governments, with Councils of Government, and with Federal Agencies in the State of Oregon.

SUMMARY

The purpose of ERSAL is to engage in cooperative projects to "close the user gap" in remote sensing applications.

The long-term objectives of ERSAL are to:

1. Maintain a center and browse file of NASA imagery in Oregon.
2. Use this imagery and help solve practical problems in:
   a) land-use planning
   b) resource allocation
   c) resource management
3. Provide consultation and instruction to those seeking advice on image analysis and remote sensing applications.
4. Extend remote sensing applications, information, and technology to new potential users and beneficiaries.
5. Identify and investigate research needs that are oriented to remote sensing applications.
6. Help coordinate remote sensing activities and projects among local, state, and federal agencies within the State of Oregon.

The ERSAL staff has changed dramatically over the reporting period. In fact, none of the present staff was working with ERSAL at the onset of the reporting period. Concomitantly, no ERSAL staff member employed on 1 April 1973 is currently working on the ERSAL staff. Thus, as would be expected, ERSAL has changed somewhat. It has become much more decision specific in the orientation it chooses on new projects.

The following are the more significant accomplishments during the report period:

ERSAL Projects

1. The Central Oregon Rural-Recreation Subdivision Inventory - This was an inventory of developed subdivisions utilizing high altitude CIR photography. That inventory was overlain on a map showing the locations of the platted subdivisions of the region. The resultant superimposition illustrated those areas in which subdivision activity was taking place and was permitted and areas in which the activity was taking

place but had not been officially recorded. The inventory has been used to develop antisubdivision ordinances (in Crook County), in developing policy statements by the Forest Service, in determining impact on wildlife habitat by the Oregon Wildlife Commission, and as a part of an Open Space Management Plan by the Central Oregon Intergovernmental Council.

2. Portland Vacant Land Project - This project involved an inventory of vacant lands on the fringes of the City of Portland. It was done for the City of Portland Planning Commission and was used by them for making planning decisions.
3. Spotted Owl Habitat Project - This project involved mapping spotted owl (an endangered species) habitat. Essentially, spotted owl habitat is old growth Douglas Fir forest. This was successfully interpreted on ERTS color IR enlargements. The inventory has been used by the Bureau of Land Management to halt a proposed timber sale.
4. Harrisburg Bridge Project - The Harrisburg Bridge Project accomplished in the Oregon State Highway Division consisted of interpreting roads, vegetation, structures, flood hazards, and slope angle on 1:30,000 CIR imagery.
5. Clatsop Plains Study Task Force - Work for the Clatsop Plains Study Task Force consisted of advising their personnel on the uses of remote sensing techniques in resource inventorying. Their staff worked in the lab to accomplish their project. They later requested us to perform a vegetation inventory of their study area. The entire package has been used to develop policy recommendations on the Clatsop Plains.
6. Marion County Land Use Project - This project consisted of ERSAL helping the Council of Governments District 4 staff perform a land use inventory and soil suitability study of a portion of Marion County. The final product was used directly in establishing a plan which resulted in a non-developmental policy of the area.

ERSAL/PIXEL (Pictorial Information Extraction and Enhancement Laboratory) Projects:

7. Tussock Moth Analysis - This project utilized ERTS imagery in a digital analysis of the northeastern Oregon-southeastern Washington tussock moth infestation. This has been one of the very few successful applications of ERTS-1 imagery for the detection of plant stress and disease.
8. Rhea Creek Study - This study entailed a classification of digital imagery of the Rhea Creek area for purposes of determining irrigated lands. This was done in the State Engineer's Office.

Continuing Projects:

9. Open Space Study - The Open Space Management Study for the Central Oregon Intergovernmental Council entails the generalization of existing vegetation maps produced under an ERTS contract and the interpretation of vegetation resources in additional areas.
10. COVEDS - The Coordinated Vegetation Digital Study (COVEDS) involves ERSAL collaboration but is primarily a project being accomplished in the Computer Center. It is designed to determine the feasibility of utilizing ERTS digital imagery in performing vegetation resource inventories.
11. Land Use of Oregon - The land use map of Oregon is nearly completed and will be given to the newly formed State Land Conservation and Development Commission. The Commission will utilize the state resource and land use map prepared by ERSAL to provide a better understanding of the geographical relationships existing among the resources and types of land uses within the state.
12. OCC&DC - ERSAL will continue to work with the Oregon Coastal Conservation and Development Commission in any way that will result in positive decisions or actions taken as a result of the interaction. ERSAL may work to fill vacancies in an uplands resource inventory left as a result of incomplete existing data.

Other Activities:

The Laboratory continued to help interested persons understand remote sensing technology. This was done through direct interaction at the Laboratory as well as by giving presentations at outside locations. One such information exchange took place in Portland and involved numerous state and federal agency personnel as well as NASA officials.

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INTRODUCTION

The Environmental Remote Sensing Applications Laboratory has been organized and is operated by Oregon State University. Laboratory offices and facilities are housed on that campus in space made available and remodeled by the University. Plans for laboratory expansion are currently being implemented.

An additional 640 square feet of space is available to the Laboratory. This space is adjacent to the existing Laboratory facilities and will provide additional staff and secretarial/clerical office space, room for the remote sensing library, and staff meeting room. This will free additional, much-needed working space in our main Laboratory and will gather on one floor, and in close proximity, all the primary Laboratory personnel, facilities, and activity.

The Laboratory is now organized as a unit directly under the Office of the Vice President for Research and Graduate Studies. This position in University administrative structure is a recent accomplishment and represents a simplification of our former structure. This was an especially significant step toward achieving an operational status as a University-wide laboratory (see Figure 1: Organizational Plan and Functional Operations Chart).

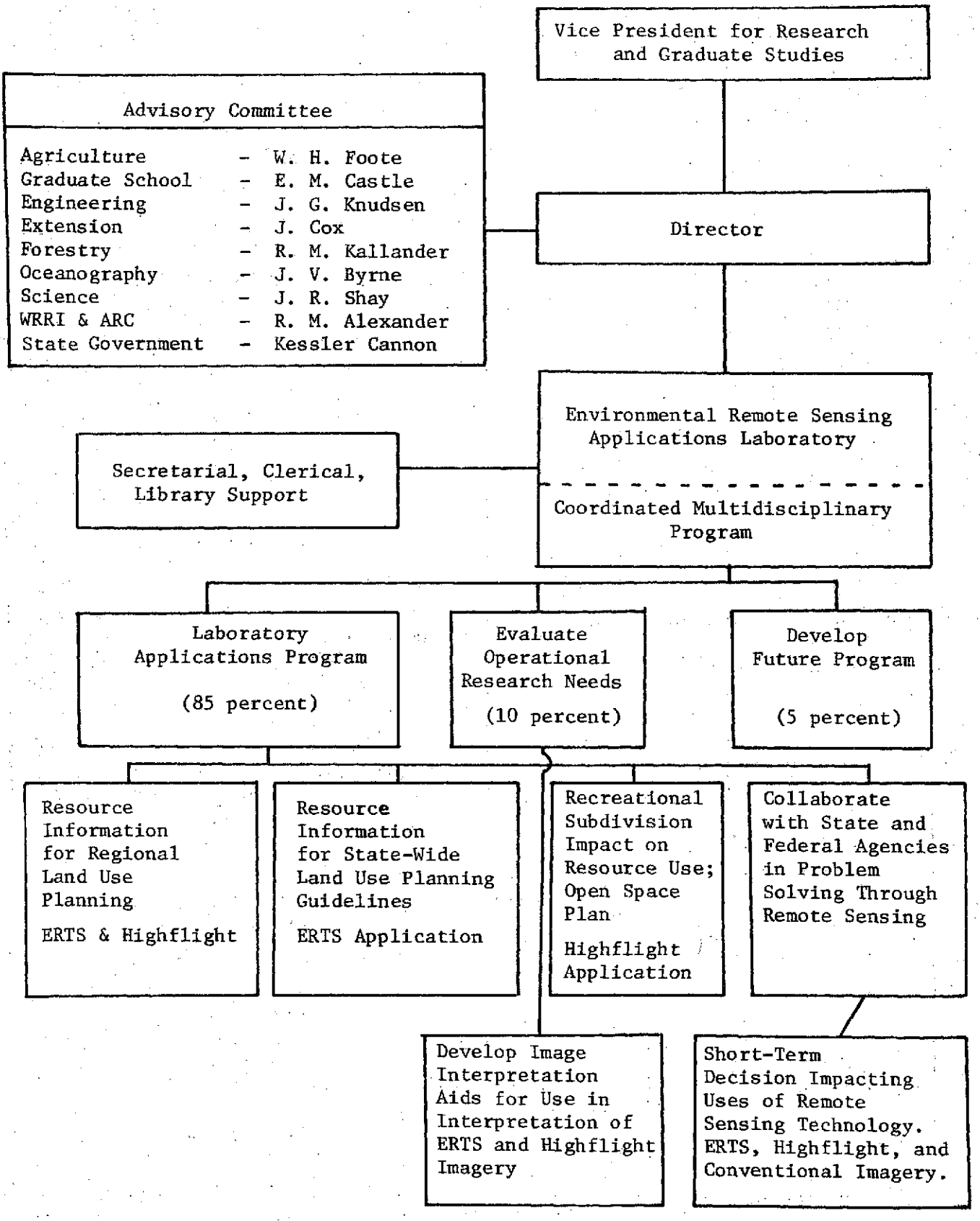
Along with the change in organization, the laboratory has undergone a complete change in personnel during the reporting period.

The past Director, Charles E. Poulton, left to join a private business. His replacement is Barry J. Schrumpf. Additional personnel still with the Laboratory who were hired during the reporting period include Deborah K. Curl, Glen R. Miller, and David A. Mouat. Additional secretarial help has also been provided. Resumes for these personnel can be found in Appendix A. James Herzog, Department of Electrical and Computer Engineering, and RJay Murray, Computer Center, are also affiliated with the Laboratory. Their resumes are also included in that Appendix.

Community Development Agent

In the summer of 1973, negotiations were made between then ERSAL Director Charles E. Poulton, and the Oregon State University Cooperative

FIGURE 1: ORGANIZATIONAL PLAN AND FUNCTIONAL OPERATIONS CHART FOR THE ENVIRONMENTAL REMOTE SENSING APPLICATIONS LABORATORY AT OREGON STATE UNIVERSITY.



Extension service to have an extension agent work with remote sensing technology in conjunction with potential users in Central Oregon. The extension agent was supposed to acquaint the potential users with the many uses to which remote sensing techniques could be applied. While the agent, Turner Bond, represented ERSAL, very little Laboratory time and no money was expended in this effort.

Mr. Bond's basic accomplishments consisted of acquainting potential users of the photographic resource. Individual contact with planners of the three local counties (Jefferson, Crook, and Deschutes) and the staff of the Central Oregon Intergovernmental Council was used to learn of problems of those planners. He also held numerous public meetings and open houses where he taught uses of remote sensing to interested persons. Instruction centered on vegetation interpretation, resource planning, land use legislation, high school education, and general community development. Extension agent Bond retired on 31 March 1974.

High Altitude Aircraft Coverage

In 1973, a considerable portion of the state was flown by NASA U-2 planes. Imagery obtained from these flights is invaluable to our operation as it expands our capabilities. Figure 2 illustrates the areas flown by NASA over the State of Oregon.

Lab Visitors

In the final quarter of the reporting period, ERSAL undertook an analysis of visitors to our facility. Monitoring the visitors consisted entirely of voluntary entries into a guest book. We feel that the figures indicate but a portion of Laboratory use. Table 1 illustrates the analysis.

Philosophy of Project Initiation and Operation

Effective communication has been established between the Laboratory and user agencies. Throughout the past year, the Laboratory has continued in its efforts to make potential users aware of the technology and practical applications of remote sensing.

The Laboratory is receptive to queries made by potential remote sensing users as to how the technology can help solve some of their

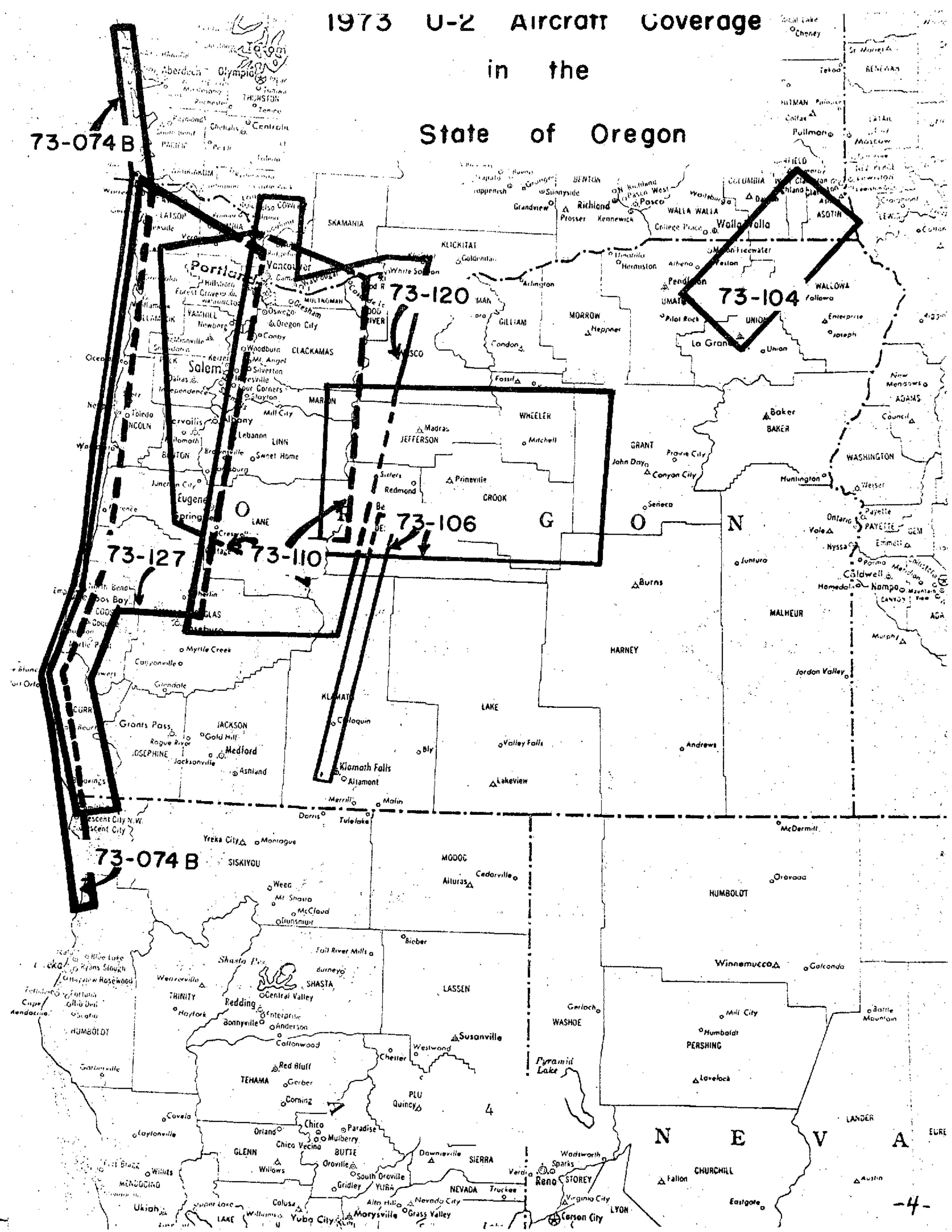

1973 U-2 Aircraft Coverage
in the
State of Oregon
73-074 B
73-120
73-104
73-106
73-110
73-127
73-074 B
O R E G O N
N E V A
Portland
Salem
Eugene
Vancouver
Klamath Falls
Medford
Burns
Walla Walla
Pendleton
La Grande
Baker
Redding
Reno
Carson City
4

Table 1:
Analysis of Visitors to the Environmental Remote Sensing Applications Laboratory, 1 January 1974 through 31 March 1974*

Disciplines	University	Planning	City or County Agency	State	Federal	Private	TOTALS
Agriculture & Soils	5	-	1	1	2	-	9
Botany	3	-	-	-	-	-	3
County Planners & COG's	-	27	-	-	-	3	30
Engineering & Power	6	-	-	-	1	3	10
Fisheries & Wildlife	-	1	-	1	5	1	8
Forestry & Range	5	-	-	4	4	1	14
Geography	17	-	-	-	1	-	18
Geology & Hydrology	5	-	-	-	2	3	10
Newspaper	-	-	-	-	-	2	2
State & Regional Planners	-	2	-	-	-	-	2
Others	15	-	-	-	-	-	15
TOTALS	56	30	1	6	15	13	121

*Based upon voluntary registration in guest book.

problems. We often help the user by educating him in the use of the techniques. We may then help him to order the imagery and then remain in contact throughout the duration of his project, offering advice and constructive criticism.

Involvement, however, begins only after considerable consultation among ERSAL staff and between ERSAL and the user agency. ERSAL will only cooperate on projects for which a direct application can be demonstrated. In addition, ERSAL is interested in potential projects which show a new application of remote sensing. Thus, an additional consideration of the Laboratory, with respect to projects, is the idea of application development of remote sensing technology as it relates to resource problems.

Projects which are engaged in by the Laboratory have a direct potential application, and a written statement by agency heads is a requirement for project initiation. Such statements specify initiation and termination dates, scale of investigation, types of resources to be analyzed, and a statement saying what the product(s) will be used for. Agencies are expected, following receipt of the product, to indicate the use(s) to which they were put. The Laboratory maintains a file of these acknowledgements. The philosophy of project initiation has not changed appreciably since the Laboratory's inception; however, the energy spent on project cooperation has changed quite a bit. The system of filing imagery and letting users know of imagery availability is now quite operational. Thus, more time is available for direct interaction with the user community. In addition, we have a better idea of potential uses of remote sensing technology related to the resource user community. As a result, we are better able to interact more efficiently with the user community.

The Laboratory was engaged in a number of projects during the reporting period 1 April 1973 to 31 March 1974. Two such projects, Collaboration on the Benton County Comprehensive Plan, and Monitoring of Field Burning in the Willamette Valley, were completed during this report period but were reported in detail in last year's Annual Report. No further work was accomplished on those two projects since last year's Annual Report. As a result, they will not be discussed here. Those two projects, did, however, represent a substantial amount of effort during the first quarter of this report period.

The following are projects which were completed between 1 April 1973 and 31 March 1974:

Rural-Recreational Subdivision Inventory in Central Oregon

The rural recreational subdivision inventory was initiated in the summer of 1972 by former Laboratory personnel at the request of Crook County Planner, Dick Brown. He and his one-man field staff had been working since August in an attempt to document subdivision development activity (road development and housing starts) by field and ground methods. In frustration they turned to us. The County Planner's Assistant came to the Laboratory and worked with our staff for a total of 20 man hours, including the time spent by our staff in consultation and joint interpretation. At the end of this period, they had obtained all of the basic information desired and had summarized same for each recreational subdivision development on a standard form we helped them develop. This information is being used in developing an ordinance in the county to enable better guidance, direction, and control of subdivision activity.

The inventory provided the following critical information about the county that was not readily obtainable from the ground:

1 Overall view of the county
2. Up-to-date information
3. Monitoring base
4. Building construction
5. Road construction
6. Areas not previously reported to have development activities
7. Distance from utilities and services

As a result of that inventory, the Crook County Planners have initiated studies to determine future needs for public services, and the effects subdivisions will have on the Prineville Reservoir. The latter study has been requested of the Soil Conservation Service.

The above-described inventory was expanded at the request of the Central Oregon Intergovernmental Council (Council of Governments,

District 10) to include Jefferson and Deschutes Counties as well as Crook County. In this expanded inventory, we had the assistance of Jefferson County Planner Brian Christian, and Deschutes County Planner Lorin Morgan. We also had assistance from Brent Lake and Russell Reeck of the Central Oregon Intergovernmental Council.

Specifically, our goals were to identify and delineate rural-recreational subdivision activity on color infrared imagery at a scale of 1:120,000. To support that task we included a detailed land ownership map which we constructed from several sources. The map included all national forest, national grassland, Bureau of Land Management, and state-owned land in the tri-county area. The product included a map as well as an overlay for a photo mosaic. We also included an overlay of recorded subdivision activity platted for each county. For that overlay, we had to compile all of the material each county had on its subdivision activity.

The subdivision overlay consisted of an interpretation augmented by extensive field checking of all subdivision activity on-going at the site. A parcel of land which was intended to be used for subdivision activity but upon which no physical development was occurring was not included in the inventory. We felt that the final map of subdivision activity in the tri-county area closely represents the actual physical activity taking place.

The recorded subdivision activity map and the interpreted subdivision map have been superimposed to indicate relative degree of activity within recorded subdivisions. The superimposition of the two maps also shows interpreted activity in areas outside the recorded subdivisions. By overlaying the subdivision activity map on the land ownership maps, the planner and user can see the pattern of development with respect to those ownership patterns. Land use conflicts are apparent when the maps are superimposed over the photo mosaic constructed as a base.

The subdivision inventory has been used by the U.S. Forest Service to develop an area guide for policy statements for the development of private landholdings that are intermingled with public land ownership. They are also able to use the subdivision activity map in their planning

of additional logging roads. The Oregon Wildlife Commission has used the inventory to identify physical changes in the land in order to properly manage deer migration. The Bureau of Land Managment has used the inventory in ascertaining potential conflicts that they may have from off-road vehicle use. Most significantly, the Crook County Planning Commission declared a moratorium based upon the inventory of additional subdivision development. This was based upon the awareness that the inventory provided of the vast extent of the subdivisions as well as the critical conflicts between the subdivisions and the land resource.

Portland Vacant Land Study

At the request of Portland City Planner Gilbert Brently, the Laboratory engaged in a project to utilize NASA-Ames acquired 1:30,000 9" x 18" color infrared photography in order to assess types and quantities of vacant land in two critical areas of west Portland. We were able to delineate parcels of land one acre in size and interpret the vacant land condition on those parcels. The types of categories of vacant land delineated were:

1. Uncultivated land
   - 1a. Uncultivated with few trees
   - 1b. Uncultivated with forest
2. Cultivated land
   - 2a. Orchards
   - 2b. Field and row crops
3. Cemeteries
4. Nurseries
5. Lakes

In the Arnold Creek area of southwest Portland, this analysis enabled the planning department to determine how much land had not been converted to urban land use. From this they projected the future needs for additional city services and determined their recommendation of how the area should be zoned. They recommended that additional development would be needed to justify extension of sewers.

In the Forest Park area of northwest Portland, the Planning Commission found from our inventory that urbanization had proceeded

at a faster rate in the area than they had originally realized. They were also made aware of developed roads in an area in which they thought none had occurred. Consequently, they now realize that city services will need to be expanded sooner than was anticipated. This need may be met by planning for those services on an updated time schedule or perhaps by influencing rate of development in an attempt to slow it down so that the development of future city service needs will adhere more closely to the previously expected time table for expanding those city services. The City Planning Commission staff is currently developing their recommendations. They also realized from this study that the selection of areas to be acquired for open space has been reduced in number and that consideration of acquiring such areas must proceed if the entire area, once developed, is to have some spots of open space.

This project has led the Planning Department to recommend a complete vacant land inventory for the entire Portland area. The decision to proceed has been impeded by other pending developments including a ballot issue to merge Multnomah County and the city of Portland. There has also been some consideration given within the Columbia Region Association of Governments (CRAG) to greatly expand the area of consideration to encompass counties in both Oregon and Washington which together constitute a quickly developing metropolis. These political considerations have prevented, to date, the further development of this project.

Spotted Owl

In the early spring of 1973, a controversy arose in Corvallis and western Oregon over the status and future of the spotted owl (Strix occidentalis caurina), an endangered species. The spotted owl is a western Oregon native that has been gradually declining in numbers in recent years. It preys nearly exclusively upon flying squirrels, wood rats, and tree mice - mammals found in old-growth western Oregon forests. The bird also prefers as its nesting tree, several hundred year old Douglas fir with broken snag tops. This species is thus effectively confined to old-growth Douglas fir forests of western

Oregon. These forests have been subjected to more intensive commercial logging activity than any other forest type in the Northwest because of their high value and low rate of annual growth.

In response to the public outcry, the U.S. Forest Service, Bureau of Land Management, the Cooperative Wildlife Research Unit at Oregon State University, the Oregon Wildlife Commission, and the OSU Department of Fisheries and Wildlife formed a committee to investigate the status of the spotted owl in the whole state and to institute measures for its continued survival.

The committee recognized, as its first order of business, the need to locate all remaining old-growth stands in western Oregon. The Forest Service representative agreed to check with the Portland Regional Office to try to provide this information. He quickly learned that the task would be so formidable - expensive in terms of labor and disruption of other high priority work - that it was impossible to provide the required information from existing and mostly outdated forestry records, if, in fact, the information existed at all. Assuming the information did exist, the cost of bringing it together from many scattered sources was beyond the capacity of all cooperating agencies, individually or collectively.

He reported this at the second meeting of the committee in late August, 1973. However, at this same meeting, preliminary results obtained by using enlarged ERTS imagery to locate old-growth stands in the Coast Range mountains were presented to the committee.

The ease of providing the required information from ERTS imagery interpretation visibly impressed the committee members. They quickly agreed that a study should be made from the ERTS imagery to locate all remaining old-growth stands in western Oregon. This was done by direct interpretation from 1:250,000 enlargements of the ERTS-1 color reconstitutions. On such a mosaic of western Oregon, it was easy to identify all densely vegetated coniferous forest areas. We then very carefully interpreted the hues of deep red of the CIR image to differentiate young, actively growing forests from older, slower growing stands. This determination alone was 80-90 percent accurate in locating old-growth forests. Additional confirmation and

corrections of the interpretation are provided by interpreting these candidate areas on the NASA highflight CIR photos. Ground checks have shown the system to be entirely reliable in locating the broad category of "old-growth forests." We feel that this "old growth" category identified and mapped by the above process will detect all actual spotted owl habitats in western Oregon.

To date, the Spotted Owl Habitat Inventory was used by the Bureau of Land Management to halt a proposed timber sale in the Oregon Coast mountain range.

The Natural Area Preserves Advisory Committee established by the Oregon Legislature in 1973, has also used the results of this study to select several of the old growth timber stands occurring on state-owned lands as candidate areas for designation as natural area preserves. Such areas will remain within their current administrative status and will be retained as examples of relatively undisturbed natural ecosystems.

Harrisburg Bridge Project

In the fall of 1973, the Environmental Section of the Oregon State Highway Division requested the assistance of the Environmental Remote Sensing Applications Laboratory to do a resource inventory of the Harrisburg Bridge Project area. The request was made to enable the Environmental Section of the Highway Department to compare their field based inventories with remote sensing augmented inventories. As a product of our efforts, the Environmental Section of the Highway Division received a base map with four overlays depicting slope angle, flood hazard, vegetation, and urban development. The entire project took approximately two man-weeks to complete.

The Environmental Section felt that our product was accomplished faster and less expensively than what they produced, and that it was most useful as the reconnaissance stage of the project. They did feel, however, that low level coverage supplemented by considerable ground truthing would be needed for final environmental decisions.

Clatsop Plains Cooperative Project

In the fall of 1973, Dr. James Pease, Extension Geographer, and Dr. William Harris, Extension Soil Scientist, received a contract

from the Clatsop County Planning Department to do an extensive resource inventory and study of the Clatsop Plains and establish managerial policies and plans for implementation in the area. They put together a team of resource specialists and planners which later became known as the Clatsop Plains Study Task Force. The Clatsop Plains are primarily a region of transverse linear sand ridges or dunes having relatively poorly integrated external drainage. They are approximately 25 miles long and 4 miles wide, and are located adjacent to the coast in extreme northwest Oregon.

The Clatsop Plains Study Task Force needed to compile maps of geology, soils, land use, drainage, and vegetation to provide the necessary resource information for their Comprehensive Plan. In order to accomplish their task with greater efficiency and facility they turned to us. A number of conferences were held last fall in order to acquaint members of their Task Force with remote sensing techniques. For several months, members of the Task Force used our zoom transferscope and stereoscopes together with the appropriate 1:30,000 highflight color infrared imagery to identify, interpret, and delineate resource units from the imagery and then transfer the information to appropriate base maps.

In addition to the resource inventories conducted by the Clatsop Plains Task Force members, the ERSAL staff prepared a vegetation map of the Plains at their request.

Vegetation Mapping Project for the Clatsop Plains Study Task Force

In a letter to us, the project leader stated that the vegetation maps were used in their Biological Inventory of the Clatsop Plains. He further stated that the maps "will be used by the Clatsop County Planning Department in the preparation of the county Comprehensive Plan and an updated zoning map."

An ERTS Digital Analysis of the Northeastern Oregon-Southeastern Washington Tussock Moth Infestation

This project was undertaken by the Electrical and Computer Engineering Department in collaboration with the Environmental Remote Sensing Applications Laboratory.

The study area was located in the Blue Mountains of northeast Oregon near the towns of La Grande and Elgin. The predominantly Douglas Fir forests of that region have considerable economic importance to private companies and government agencies. Unfortunately, they have become severely infected by infestations of tussock moths. In order for the diseased regions to be effectively managed and controlled, locations of the diseased trees must be pinpointed. The sequential coverage provided by the ERTS-1 system was felt to represent an extraordinary opportunity to locate the infected trees.

Personnel from Oregon State University, the State of Oregon Department of Forestry, and the Boise Cascade Corporation selected twenty-six test sites to provide multivariate statistics for use in the automatic classifier algorithm. The test sites included several forest stocking densities and four degrees of moth damage.

The classification system was used to prepare maps of the 200 square mile region delineating regions of no damage, light damage, medium damage, and heavy damage among the high density timber of the region. The results were judged to have a "very high" degree of correlation with the actual damage.

This is one of the very few successful applications of ERTS-1 imagery for the detection of plant stress and disease. The ERTS project reports contain few applications to plant disease detection that are more significant. Operational methods for mapping the tussock moth defoliation utilized by the U.S. Forest Service and State Department of Forestry include flying transects over the forest while an observer delineates on map areas that have been attacked. The resolution that such mapping achieves is much coarser than ERTS capability. Consequently the observer includes some meadow areas supporting no trees in his mapping of heavily infested trees. The Boise Cascade Corporation had a crew of 100 men in the forest for two weeks determining the location and extent of damage. It was on the basis of what they determined that Chuck Johannesburg, Forester for Boise Cascade Corporation, judged the mapping job with ERTS to be highly accurate. The primary drawback to the remote sensing approach with ERTS is the length of time that it took to provide the needed information. The field crews

were operating to complete collection in the early fall. Current year's damage is best detected during middle to late September. The time required to acquire ERTS tapes does not permit meeting those kinds of deadlines.

Classification of Digital Imagery for the State Engineers Office - The Rhea Creek Study

This project was undertaken by personnel of the Computer Center in collaboration with ERSAL.

The Water Resources Division of the State Engineers Office is responsible for enforcing compliance with "water rights" grants and are therefore interested in methods of monitoring water usage, primarily irrigation.

The purpose of the study was to ascertain the feasibility of using ERTS-1 digital imagery classification to detect where and how much irrigation was occurring on Rhea Creek. Rhea Creek is located in north-central Oregon and flows into the Columbia River.

In August the only green vegetation would be associated with some type of surface or near surface water - irrigated land and stream beds, for example. Annual vegetation is dormant.

Density slicing was used to select the lowest band 4, 5, and 7 intensities. Band 4 gave the best priority gray scale outlines of creeks and draws. The lowest intensities (assumed to be green vegetation) occurred in the creek bottoms and were generally within the boundaries of irrigated fields.

The digital imagery and water rights map were scaled to 1:24,000 USGS topographic maps and were drawn on a CalComp drum plotter. The scale factors were not rigorously determined and the digital imagery was probably mismatched by a pixel or two. It was felt that some pixels classified as vegetation were more likely shadows on north slopes.

The State Engineer's Office felt that the preliminary results were of significant interest but were inadequate in detecting proof of water rights violation due to resolution. The State Engineer's Office was sufficiently impressed to want to continue exploring ERTS applications.

Marion County Land Use Project

Early in 1974, the Council of Governments District 4 (Central Willamette Valley) Planners Dennis Lewis and Curt Smelser met with the ERSAL staff to determine the feasibility of using 1:30,000 and 1:120,000 scale color IR photographs in determining land use patterns and soil suitability for urban development for an area in southwest Marion County. The area is known as the Jefferson-Ankeny bottom. It is one of the primary agricultural areas in the Willamette Valley. After a couple of meetings, it was decided that an intern provided by COG D-4 planners would work in the Laboratory with ERSAL personnel in accomplishing the task. The interpreted photographs were ultimately transferred to a base map using our zoom transfer scope.

The final product was instrumental in a zoning decision. It showed the nature of the existing land use and the sizes of existing land parcels. It also indicated that the soils were poorly suited to handle sewage effluent. The Marion County Planning Department had, one year earlier, decided on a plan that would eventually fragment the Jefferson-Ankeny bottom. After the Council of Governments District 4 planners presented their evidence, the Marion County Commissioners decided to adopt a zoning plan which would maintain the existing character of the terrain.

CONTINUING PROJECTS

Open Space Inventory

The Open Space Inventory is an extension of the Central Oregon Rural-Recreational Subdivision Inventory discussed previously. The Open Space Inventory is in cooperation with the Central Oregon Intergovernmental Council. It covers the tri-county area of Jefferson, Crook, and Deschutes Counties. The Central Oregon Intergovernmental Council will use this product as an integral portion in their open space land management plan.

Basically, the Open Space Inventory will consist of maps showing areas of subdivision activity, of agricultural areas, of unusual scenic areas, and of vegetation types. The subdivision activity map has already been completed. The agricultural map has been completed and was accomplished using photo interpretation techniques on 1:120,000 color IR photos. A portion of the vegetation map was completed during an ERTS investigation of Crook County. ERSAL will utilize that existing map for a portion of the Open Space Study.

Vegetation and Land Use of the State of Oregon

In mid 1973, after conversations with Mr. Kessler Cannon, then Assistant on Natural Resources to the Governor, Dr. Charles Poulton developed the idea of testing the usefulness of ERTS-1 imagery for mapping vegetation and the conditions of land use of the State of Oregon. With national land use legislation being discussed and the imminent formation of the Oregon Land Conservation and Development Commission (LCDC) set for early 1974,[1/] the opportunity of showing the LCDC what may be determined from a satellite view of Oregon seemed promising. In addition to demonstrating the levels of detail available from the satellite imagery, the map shows a synoptic view of land use relations in Oregon. The synoptic view is clearer on a photo base than on a standard map or chart.

1/ Oregon Senate Bill 100, the 1973 Land Use Bill was passed to coordinate state and local land use planning programs; assist in strenthening local planning efforts establish statewide land use goals; identify areas of statewide critical concern and guarantee public involvement in planning processes. Senate Bill 100 created the LCDC.

Vegetation and land use have been mapped from color transparencies of ERTS-1 images in six classes and from two to five levels of detail discernable from the imagery. The photo delineations have been placed as an overlay on a mosaic of Oregon constructed from ERTS imagery. Because the delineations were much more detailed than could be conveniently understood by a lay audience, the overlay is being generalized to show agricultural land, urban development, forest, and semi-arid rangeland. Each of the four classes was shown as a separate overlay for ready comprehensibility and ease of display.

The land use map work will be presented to the LCDC as an example of the use of the space viewpoint as a source of information about surface conditions. The Commission recognizes the usefulness of the map and overlays for presentation of the resource base of the state to the public. In addition, the mosaic and map may be further used as focal points for identification, location, and discussion of areas of statewide critical environmental concern.

During this spring, the Commission staff has organized and conducted a series of town meetings throughout Oregon. Each meeting has been well attended by the public, and the meetings consisted primarily of public participation. In this manner the Commission has been able to gather, by direct contribution from the public, feelings pertaining to the important values of Oregon and how development of the State should be planned. From this, the Commission is preparing a set of preliminary policy statements for land use planning and development for the state. A second series of town meetings is planned for next fall during which the preliminary policy statements would be reviewed and evaluated by the public. The Commission would utilize the state resource and land use map prepared by ERSAL during these meetings to help provide a better appreciation on the part of the public of the geographical relationships existing among the resources and types of land uses within the state.

As an information base in itself, the land use map is a base of evolution for an expanded information system. The land use legend classification is based on ecologically consistent vegetation, geologic, and human development relationships and is capable of expansion to

successively more detailed classification with continued consistency and increasing usefulness for specific land use decision making. An additional purpose of presenting the work to the LCDC is to elicit suggestions for specific short-term projects based on either the techniques used to produce the land use map such as detailed county or regional analysis or any project using the facilities and technology available through ERSAL.

Coordinated Vegetation Digital Study (COVEDS)

Early in 1974, a need was expressed by many state and federal agency personnel for vegetative cover data. A comprehensive plan team for the Pacific Northwest River Basins Commission decided to consolidate efforts into one research team. The overall objectives of the program are to ascertain the minimum procedures and data requirements necessary to implement a computer-aided classification system based primarily on ERTS digital imagery that will be an operational tool for resource management by the user agencies. The Environmental Remote Sensing Applications Laboratory and the Oregon State University Computer Center are undertaking a cooperative project in a 1000 square mile central Oregon coast test site to accomplish a pilot study of this objective.

If the study is successful, then a computer assisted program will be developed as an operational system to cover the entire state.

Oregon Coastal Conservation and Development Commission

Continued cooperation between the OCC&DC and ERSAL is anticipated throughout 1974. Primary areas of interaction are anticipated in gathering resource information in "upland forest" areas where no information is available and where ground access is difficult. The purpose of such interaction is to provide the OCC&DC with inventory information with which to make coastal zone policy decisions. To date, no specific projects have been formulated.

FUTURE PROJECTS

Besides continuing with the afore-mentioned projects, ERSAL will be developing new projects throughout the remainder of 1974 and the beginning of 1975. Possible areas of involvement are in the fields of agriculture, irrigation, snowpack monitoring, natural area preserves, and of course, vegetation resource inventories. Prime motivating points of consideration in adopting and developing new projects are the uses and applications to which the products will be put.

ERSAL EDUCATIONAL ACTIVITIES

As a part of the initial purpose of inception, we have continued our cooperation in the field of educating potential users of remote sensing applications and technology. During the 1973-1974 reporting period, we were asked on numerous occasions to engage in various presentations on remote sensing. These opportunities included presentations to planners in central Oregon, northeast Oregon, the Oregon Coastal Conservation and Development Commission, Benton County, the State Water Resources Board, the Oregon Highway Department, a Tillamook County planning meeting, and the City of Portland, among others. More lengthy involvement included collaboration with a Forestry Remote Sensing Short Course, and a Remote Sensing Symposium sponsored by United States Senator from Oregon, the Honorable Mark O. Hatfield; Goddard Space Flight Center; the Oregon Museum of Science and Industry; and Oregon State University. The program was developed primarily by Dr. Stanley Freden (GSFC) and Dr. Charles E. Poulton (ERSAL), and was designed to review ERTS applications in Oregon and to procure feedback from the symposium audience identifying future remote sensing, natural resource, and land use information needs as they recognized them. An information copy of the Proceedings of this symposium accompanies this report.

PROJECT DEVELOPMENT

Through the first two years of ERSAL's existence, sufficient experience has accumulated to permit some generalizing with regard to searching for cooperative remote sensing projects which result in a specific action taken or specific decision made based at least in part on the information developed during the project. Finding such projects is often quite difficult, but there are a few guidelines which can help to minimize some of the frustration.

Project development depends initially on lab exposure and awareness of remote sensing on the part of the potential user. Achieving exposure means participating in local symposia; speaking to local groups (foresters, agriculture commodity producers, land use planners); appearing on local television (Cooperative Extension agriculture program); helping newspaper reporters prepare articles describing remote sensing, the Laboratory, and its functions; providing assistance to university map librarians in obtaining ERTS imagery; issuing a Laboratory newsletter; utilizing university information services to release announcements about new grants, Laboratory program objectives, and achievements; and generally developing and maintaining communication with a comprehensive selection of state, county, and city personnel (direct personal contact and/or newsletter).

Efforts directed toward achieving exposure remain important for maintaining the continued effectiveness of the Laboratory program; however, they have been especially valuable during the first two years. The load of carrying out further exposure is thereafter partially shifted to those people who initially received the exposure. Much of the important exposure is then by "word of mouth" passed among users and potential users. If the cooperative projects are producing useful results, then there is a definite psychological advantage to having the exposure by "word of mouth." The person who is then hearing about the Lab (ERSAL) for the first time develops the feeling: "If these other guys can get information and maps that are that good by working with ERSAL, then there may be something in the ERSAL program for me, too." This situation has distinct advantages over the opposite line of

thinking: "Here come those guys from that remote sensing lab trying to tell me I can get what I need from a satellite photo." Exposure by "word of mouth" can be negative as well as positive. To avoid the negative, it is necessary to not oversell remote sensing, to produce on projects, and to have the people who will utilize the products involved in the study and preparation of those products so that they will understand the strengths and limitations of the procedures used, and the impact that those strengths and limitations have on the utility of the final product.

Many people have come to recognize the Laboratory as a convenient center at which they can have their first glimpse of a satellite's view of the world or their first conversation about remote sensing. ERSAL becomes, therefore, much more to most people than just a lab to complete cooperative projects resulting in specific actions. However, what is required of the ERSAL program to meet the needs of these people is primarily a public relations function. At this point, it is necessary to realize that the Lab cannot be all things to all people, especially when it becomes evident that what they want may be familiarization, training, short courses, speakers at classes, or to use the Lab as an imagery source. To undertake such functions would not only jeopardize achieving the Laboratory's cooperative projects, but would be overstepping the purpose of the Laboratory. At the same time, a minimum of this type of public relations work is necessary, accompanied by an application of policies regarding the provision of imagery and remote sensing training. Greeting visitors to the Laboratory, explaining the program, and supervising their viewing of ERTS and U-2 imagery quickly becomes an important Laboratory function, because if it is not done well it will contribute to the negative, rather than the positive, "word of mouth" exposure.

Accomplishing exposure will lead to contacts that may in turn develop into the desired project. A contact being developed between a state agency person and Lab personnel, for the purpose of exploring a specific project idea, needs to be made with the appropriate agency person. Because the project needs to have a high likelihood of resulting in a specific action, this means that the Lab personnel must

have an appreciation of the decision making procedures of the agencies, e.g., at what levels in the agency are different decisions made. If the contact is not made and the idea developed with an agency person in a decision-making position, then the project may never get off the ground because agency participation cannot be secured, or if completed, the project results are much less likely to be utilized.

Making the appropriate contact is also critical when it represents the first one made with an agency or other type of organization. This contact may open the way to a fertile area for project development, or it may close the door if not handled properly.

Perhaps the most effective way to proceed is to seek out those individuals who have independently developed an interest in remote sensing. They will be, for the most part, far more receptive to the idea of utilizing new techniques than another person who is content with the way operations are currently rolling along. To attempt to "hard sell" the latter type is a waste of time.

Agreements between the University and state, county and city agencies, are much easier to arrange than those with private business. With the former, it is much easier to come to an agreement (when it is necessary) on such points as rights to ownership of the final product, rights to publish, and review of materials prior to publication.

Consideration is also possible of sharing project costs with the cooperating agency. This should be a secondary consideration, with that of identifying and completing decision impacting projects being primary. Realistically speaking, attempting to achieve some kind of cost sharing arrangements will add 2-4 months on the length of time it takes to develop and initiate a project, or might even terminate the project development. It might seem that if an agency were to put up dollars in support of a project that this would tend to insure the utilization of the project product. However, experience indicates that this is not necessarily the case, and this does not provide an incentive for seeking dollar support from the cooperating agency.

Remote sensing can be well used to gather information for environmental impact statements. However, these statements may not amount to more than a formality. Once they have been prepared there is no

legal provision requiring that their content be considered by the organization required to prepare the statement. The likelihood of a remote sensing project, which contributes to an environmental impact statement, of resulting in a specific action or decision is therefore minimal. It does not therefore appear to be fruitful to pursue these types of projects.

Another type of project to avoid is that in which a specific type of information must be in the decision makers hands within some relatively short period of time following some specific occurrence. Potentially, operational satellite imagery will be exactly what is needed for these types of situations, however, current turn around time on imagery is too slow to be able to meet the necessary deadlines.

Policies and plans pertaining to the future use of land and water resources have been, and are continuing to be developed which contain critical assumptions and projections of population and development trends. Frequently these assumptions and trends pertain to subjects which are readily and accurately detected by remote sensing. Monitoring should provide the necessary feedback to reveal if, in fact, the changes and developments forecasted truly do become reality. Adjustments can then be made if necessary, in an action program in order to contribute to the credibility and efficiency of that program.

These thoughts and guidelines are permitting us to better utilize our laboratory resources, to be more selective in our expenditure of time, and to be more successful in ferreting those projects which will truly result in application. They are included here to indicate some of the additional functions which are needed to carry out our programs. They have also been included to indicate the evolution of our project involvement and development.

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Positions: Chicago Aerial Industries, Barrington, Illinois, electro-optical aerial reconnaissance systems, 1959-60;
Bell and Howell Company, Chicago, Illinois, industrial design, manufacturing engineering, development of cameras and tape recording equipment, 1961-62;
Teletype Corporation, Skokie, Illinois, research engineer, 1962;
Jet Propulsion Laboratory, Pasadena, California, research engineer of spacecraft communications, 1963;
Man-Machine Systems Lecturer, University of Michigan, 1965-67;
Associate Professor of Electrical and Computer Engineering, Oregon State University, 1967 to present.

Professional Field: Hybrid computation, control systems, cybernetics, bioengineering.

Selected Publications:

Herzog, J. H., and R. C. Rathja. 1973. Comparative evaluation of spatial features in automatic land use classification from photographic imagery. Submitted to Conference on Machine Processing of Remotely Sensed Data, October, 1973.

Simonson, G. H., J. H. Herzog, et al. 1973. Natural resource inventory and monitoring in Oregon with ERTS imagery. Conference Record, NASA Conference on Applications of ERTS Imagery, March, 1973.

Herzog, J. H., and A. K. Nandi. 1971. Output controllability, canonical structure and feedback. Proceedings of the Fifth Annual Princeton Conference on Information Sciences and Systems, March, 1971.

Herzog, J. H., and A. K. Nandi. 1971. Comments on "Design of a single input system for specified roots using output feedback." IEEE Transactions on Automatic Control, August, 1971.

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Research Assistant, remote sensing bibliographic abstracting, U.M. Institute of Science and Technology, Michigan, 1971;
Research Assistant, multispectral line scanner analysis, U.M. Willow Run Laboratories, Michigan, 1971;
Research Assistant, computer information retrieval system, Center for Remote Sensing Information and Analysis, Willow Run Laboratories, Michigan, 1971-72;
Graduate Research Assistant, forest inventory applications of ERTS-1 data, Oregon State University, Oregon, 1972 to present;
Graduate Research Assistant, Environmental Remote Sensing Applications Laboratory, Oregon State University, Oregon, 1973 to present.

Professional Field: Remote sensing image analysis, forest inventory, forest entomology, rangeland management.

Selected Publications:

Paine, D. P., Roger A. Rogers, and Glen R. Miller. 1973. Progress report on the Ochoco National Forest inventory using ERTS and supplemental aircraft imagery. Presented at NASA-Oregon Museum of Science and Industry Symposium, Portland, Oregon, 9 November 1973.

Miller, Glen R. 1972. Aerial detection of *Fomes annosus* by date, scale, and film type. M.S. Thesis, Univeristy of Michigan, Ann Arbor.

Rentz, David C., and Glen R. Miller. 1971. Ecological and faunistic notes on a collection of Orthoptera from South Korea. Ent. News, 82:253-273.

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Degrees: B.A., 1966, University of California, Berkeley
M.A., 1968, Kent State University
Ph.D., 1974, Oregon State University

Positions: Teaching Assistant, Department of Geography, Oregon State University, 1969-71;
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Research Assistant, Environmental Remote Sensing Applications Laboratory, Oregon State University, 1972-74;
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Professional Field: Geomorphology, geoecology, plant ecology, remote sensing, resource analysis.

Selected Publications:

Schrumpf, Barry J., James R. Johnson, and David A. Mouat. 1973. Inventory and monitoring of natural vegetation and related resources in an arid environment: A comparative evaluation of ERTS-1 imagery. Type II Progress Report for period 1 September 1972-28 February 1973. Goddard Space Flight Center, Greenbelt, Maryland, 20771. 30 March 1973.

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Mouat, David A. 1970. Landform-soil relationships in Northeastern Ohio. Abstract of paper presented to the Oregon Academy of Sciences, Eugene, Oregon. IN: Proceedings of the Oregon Academy of Sciences. Vol. VI. 17 pp.

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Professional Field: Computer science, numerical analysis, physical and organic chemistry, rheology of polymers.

Selected Publications:

Kosolapoff, G. M., and R. J. Murray. 1966. Synthesis of some phosphorus-containing polyamides. Presented at IUPAC International Symposium on Macromolecular Chemistry, Kyoto-Tokyo, Japan. 28 September-4 October 1966. (Master's Thesis).

Kruse, R. B., and R. J. Murray. 1963. Comment on "Stresses and Strains in Solid Propellants During Storage." AIAA, 1, pp. 246-247.

SCHRUMPF, BARRY J.

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Degrees: B.A., 1966, Willamette University
M.S., 1968, Oregon State University
Ph.D., expected 1974, Oregon State University

Positions: Graduate Research Assistant, Range Management Program, Oregon State University, 1966-68;
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Research Assistant, Rangeland Resources Program, Oregon State University, 1970-73;
Principal Investigator, NASA Funded ERTS-1 Project, Oregon State University, 1973 to present;
Acting Director, Environmental Remote Sensing Applications Laboratory, Oregon State University, 1974 to present.

Professional Field: Range ecology, remote sensing, resource inventory and analysis.

Selected Publications:

Schrumpf, Barry J., James R. Johnson, and David A. Mouat. 1973. Inventory and monitoring of natural vegetation and related resources in an arid environment. Type II Progress Report #2. Rangeland Resources Program, Oregon State University, Corvallis.

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SCHRUMPF, BARRY J.

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Co-author of Annual Progress Reports to NASA for years 1968, 1969, and 1971, entitled, "Inventory and Analysis of Natural Vegetation and Related Resources from Space and High Altitude Photography," and a science screening report of the Apollo 7 (AS-205) photography.